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13. ABSTRACT *(Maximum 200 Words)*

Following the 1991 Gulf War, the Department of Veterans Affairs (VA) in late 1992 and the Department of Defense (DoD) in 1994 initiated health registry programs to provide clinical evaluations of Gulf War veterans. By September 30, 1999, 100,339 unique veterans participated in either the VA Persian Gulf Registry (PGR) or DoD Comprehensive Clinical Evaluation Program (CCEP). The following efforts were completed on this combined registry project::

1. Merging of VA PGR and CCEP with linkage to other data resources,
2. General descriptive report on the demographic and military characteristics, overall symptom and diagnosis reporting, and self-reported exposures of the combined data,
3. Patterns of symptoms and diagnoses over 7 year period (1993-1999),
4. Patterns of VA health care utilization, both inpatient and outpatient care, by registry participants,
5. Patterns of VA compensation for service-connected conditions,
6. Selected case-control analyses to evaluate potential risk factors associated with selected medical conditions.

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Table of Contents

I. INTRODUCTION

Following the 1991 Gulf War, both the Department of Veterans Affairs (VA) and the Department of Defense (DoD) established health examination programs to monitor and evaluate the health status of Gulf War veterans (GWV). VA established the Persian Gulf Registry (PGR) program in late 1992 to offer medical examinations to former military persons who served in the Gulf theater and were separated from the military.[1,2] The DoD initiated the Comprehensive Clinical Evaluation Program (CCEP) in 1994 to provide examinations to military personnel who served in the Gulf theater and their eligible family members.[3] Both personnel who are actively serving and those retired are eligible for the CCEP program. Both registry programs were designed to collect systematic medical information on the symptoms and illnesses experienced by the GWV. In addition, each program collected some demographic information and some self-reported exposure data.[4] Participants of both programs were self-selected; they voluntarily requested and participated in the evaluations. The Environmental Epidemiology Service (EES) has worked with both the VA PGR and CCEP data for some time. The purpose of this project was to combine the CCEP and VA registry data in such a way that would protect the identities of the registry participants and allow for the linkage of the data to other resources. The registry data and other linked databases could then be distributed to VA and DoD members of the combined registry project for their own specific analyses. In addition, it was the responsibility of EES to provide a detailed evaluation of the

combined data that would form the basis of the descriptive monograph to be headed by Dr. Kenneth Craig Hyams. Finally, EES was to conduct nested case-control analyses of selected conditions.

II. BODY

1. MERGING AND LINKAGE OF THE DATA

The major focus of this project involved the combining of the two clinical databases in such a way as to allow for the combined analysis of the data. A combined study of these two clinical databases will provide more useful information than individual analysis for several reasons. First, combining the registries affords a larger number of evaluated Gulf War veterans for analysis, which increases the chance of detecting a rare or less clinically obvious abnormality. Combined analysis also will provide greater numbers and increased statistical power to conduct subgroup analysis by gender, age, location, and time of Gulf War service. Another value of combined analysis is that it allows for comparison of health problems between different populations of veterans: those who remained on active duty after the war and veterans who left active military service or entered the inactive Reserves/National Guard and became eligible for VA health care. Finally, combined analysis will permit longitudinal assessment of illnesses over a multi-year period among veterans who participated in both registries.

For VA, the first objective of this project was to combine the data from the CCEP and the PGR in a manner such that the identity of the GWV who had

participated in either registry examination program would remain anonymous to both VA and DoD investigators. It was also necessary to develop a system in which additional databases such as military and demographic files, hospitalization files, vaccination files, and Gulf War exposure files could be linked to the clinical examination data. VA generated a randomized VA personal identification number (VA PIN) for each Social Security Number (SSN) of the 696,470 veterans who were deployed to the Gulf theater sometime between August 2, 1990, and July 31, 1991. This project limited its analyses to those GWV to persons who served during the first year because of the potential for exposure to various hazardous agents. This roster of GWV was matched by SSN to the DoD CCEP and VA PGR databases to identify persons initially eligible for inclusion in this combined registry analysis project and to substitute the VA identification number for each individual's SSN. Participants of this combined registry analysis were further restricted to those persons who had completed their registry examination by September 30th, 1999. Additional databases as mentioned above were matched to the roster of GWV, SSNs were replaced with the cooresponding VA PIN, and all other personal identifiers were deleted from each newly created database. The two registry databases as well as the supplemental data files with only the VA PIN for identification were distributed to the investigators of this combined registry project. There were 32,876 CCEP registrants and 70,385 PGR registrants who met all the eligibility requirements as described. This resulted in 100,339 unique GWV including 2,922 GWV who were examined in both the CCEP and the PGR (see Figure 1).

By October 1, 1999, slightly more than 14 % of the GWV population deployed to the Gulf theater prior to July 31, 1991, had been examined in either the DoD or VA clinical registry programs.

Structural differences in the format of the CCEP and the initial and revised formats of the VA PGR prevented the actual merging of the medical data contained in the various registry databases. The CCEP database recorded text only information on the individual's self-reported chief complaint and up to 6 other complaints as well as using a checklist approach to record the presence or absence of a number of commonly reported symptoms. In addition, the CCEP data recorded a primary diagnosis and up to 6 secondary diagnoses. The PGR has had two separate formats as a result of a major revision and expansion of the original codesheet that was conducted in 1995. In the data examined here, the original VA PGR codesheet was used for about 70 percent of all the records on the VA computerized file. On the original codesheet, up to three complaints and three diagnoses could be recorded. However, the revised codesheet could record up to 10 symptoms and 10 diagnoses during the initial examination and even more if the patient was recommended for and completed Phase II. Because of variation in data formats, VA has always reported the analyses of the medical data from the two PGR formats separately.

The merging of the CCEP and two PGR systems with regard to symptom and diagnostic codes is technically possible. However, correct interpretation of the analyses of the merged data would be complicated by the variation in the structures of the three databases. In view of the lack of comparability of the

structures of each database, data from the two registry programs have not been physically merged. For this report, data are reported separately by source (CCEP, initial VA, and revised VA). This approach has revealed important differences in the underlying populations represented in each database that appear to be related to the eligibility issues for each registry program. Due to the self-selected nature of the registry data there is the potential for selection bias, and the patterns of illness and the participation rates observed are not necessarily representative of the entire population of GWV. Nonetheless, data generated from both programs can provided clues to the types of problems experienced by the participants of the Gulf War.

2. GENERAL DESCRIPTION

After the data from the CCEP, the VA PGR, and related clinical and military databases were linked by an anonymous VA PIN, VA proceeded with a systematic evaluation of the registry data. Consultation and tabulations as requested were provided to Dr. Kenneth Craig Hyams for inclusion in the combined registry monograph titled "**Combined Analysis of the VA and DoD Gulf War Clinical Evaluation Programs.** ***A Study of the Clinical Findings from Systematic Medical Examinations of 100,339 U.S. Gulf War Veterans.***" The tables that follow provide a general description of the population of 100,339 GWV examined in either the VA or DoD registry programs.

Table 1 provides selected demographic and military characteristics of the registry participants. The participants of the CCEP and PGR were slightly older

at the time of the Gulf War than the overall deployed population of approximately 696,000 personnel. The CCEP had a higher proportion of nonwhites compared to the PGR and the overall deployed population. Approximately 10 % of each registry population were female compared to only 6.9 % of the entire deployed group. The proportional distribution by branch of service varied between registry programs and between the registry population and the total deployed population. Approximately 50 % of the entire deployed group were Army personnel, but 85% of the CCEP and over 70 % of the VA registry were Army. The proportion who were Navy personnel was lower in the registry groups (4 % CCEP and between 7 to 9 % of the VA) compare to the 22 % of the deployed population who were Navy. Only 5 % of the CCEP served in the Marine Corps while 13 to 14 % of the VA registry and the deployed population served in the Marine Corps. A higher percentage of the CCEP and the deployed population were active duty personnel (91 % and 84 % respectively) compared to the initial VA (57 %) and the revised VA (76%). The high proportion of reserve and guard forces in the initial VA (43%) was in part due to the early eligibility of these forces to VA services. The proportional distribution of the time arriving in the Gulf theater was very similar in the three registry programs. Persons examined in the CCEP were more likely than VA registry personnel to have served in Iraq or Kuwait, but the percentage having combat MOS codes or having a total suspended particulates exposure level greater than 260 ug/m^3 were similar across all registry programs. Slightly more CCEP personnel had been present at Khamisiyah than were VA registry personnel. Differences in the profiles of the populations represented in the

various registry programs make it necessary to control for many of these characteristics in any analytical assessment of these data.

Table 2 presents the percentage distribution of some of the more common symptoms or complaints recorded in the registry data. For every symptom category, the percent reporting that symptom is higher in the revised VA program than in the initial program and higher yet for the CCEP. While both the initial and the revised VA registry formats require the GWV to report his or her symptoms, the initial VA was designed to capture only 3 symptom codes while the revised VA program could capture up to 10 symptom codes. Also the initial VA was forced to code everything to ICD codes 78--- (symptoms, signs, and ill-defined conditions) while the revised VA allowed for the use of the full range of ICD codes. The CCEP, however, was designed to capture symptoms in a physician-elicited checklist system in which the GWV was asked about whether they suffered from each specific symptom. Joint and muscle pain was the most frequent complaint in both the CCEP and revised registry programs. The structural differences seen in the three registry formats clearly make it impractical to try to compare the actual percent reporting from one registry program to the other. The checklist approach of eliciting symptoms appears to result in a consistently higher percentage of reported symptoms.

Table 3 presents the percentage distribution of diagnoses recorded for persons examined in the CCEP and VA PGR programs. This table evaluates the frequencies of all the diagnoses recorded. For the CCEP, that included the primary diagnosis and up to six supporting diagnoses. For the initial VA

program, up to three diagnoses could be evaluated, and for the revised VA, up to ten diagnoses. There appears to be much better agreement between the CCEP and revised VA programs for the diagnostic data than for the symptom data. The percent distribution of each diagnostic category for the initial VA registry data do seem to lag behind the CCEP and revised VA data. Note that ICD 78--- through 79--- which are designated Symptoms, Signs, and Ill-defined Conditions are recorded for 42 % of the CCEP but only 3 % and 12 % of the initial and revised VA programs. This is again a reflection of differences in the definitions and procedures utilized by the different programs. The rank order of the most frequent diagnoses does appear to be the same across the three registry programs. The two most frequently recorded diagnoses for each registry system are diagnoses involving the musculoskeletal system and connective tissue followed by diagnoses involving mental disorders.

Similar types of questions appear in the CCEP and revised VA PGR that allow for the self-reporting of potentially hazardous exposures while in the Gulf theater. Table 4 presents the % reporting these various exposures in the CCEP and in the revised VA data. The initial VA registry did not record comparable exposure data. The most frequently reported exposure in both registry programs was exposure to diesel and other petroleum fumes (77.6 % of the CCEP and 90.9 % of the revised VA participants reported this exposure). There is a lot of variability between registries in the percentage reporting any particular exposure that may be explained by the differences in the underlying populations included in the CCEP and revised VA registries.

Figure 2 shows the frequency of the number of persons examined by year of examination for the CCEP and VA registry programs. While the VA program started earlier than the CCEP program and examined a greater magnitude of GWV during those first few years, by 1995, the frequency of new examinations recorded for the two programs closely resembled one another. The increased frequency in new examinations conducted in 1997 that may be attributed to increased media coverage and concerns about exposures related to Khamisiyah are reflected in parallel blips in the graphs for the CCEP and VA registry programs. As of data through September 1999, there appears to be a continual trailing off in the number of new examinations conducted by both programs.

3. SYMPTOM DATA BY CALENDAR YEAR OF EXAM

Table 5 presents the percent distribution of ten common symptoms in the CCEP by calendar year of examination. These symptoms in the CCEP are part of a checklist of symptoms to which the examinee must indicate if he or she has experienced. These are often referred to as physician-elicited symptoms. Within all of the symptom categories, there is considerable variation from year to year in the percent of persons examined who report having the symptom in question. A common pattern for each of the reported symptoms is that compared to all other examination years, 1997 always has the highest proportion of persons who report a particular symptom. Also, there is always a dramatic drop off with almost no reporting of that symptom in 1998. To exam these patterns further, the distribution of the number of symptoms reported by calendar year was examined.

The percent reporting no symptoms was 20 %, 21 %, 15 %, and 16 % from 1994 through 1997, but jumped to 92 % and 74 % in 1998 and 1999. The data seem to indicate that just as the interest in coming in for a CCEP examination trailed off in 1998 and 1999, the number of symptoms/complaints reported by each person trailed off as well. Despite the variation from year to year, within any given year, the top three most frequently reported symptoms were joint and muscle pain, fatigue, and headaches.

Table 6 presents the percent distribution of the symptoms recorded in the initial and revised VA registry databases. As reflected in the layout of the table, the initial VA registry codesheet was use to record examinations in the years 1992 through 1995, whereas the revised VA codesheet was used to record examinations from 1996 forward. The initial codesheet was very different structurally than the revised codesheet with the former recording up to three symptoms compared to 10 in the revised. Symptoms on the old codesheet had to be coded using a 78--- series ICD 9 Code (Symptoms and Ill-Defined Conditions) while the full range of ICD Codes could be used to code symptoms on the revised codesheet. For any particular symptom on Table 6, the distribution by year of examination for either type of codesheet was reasonably stable. There is a distinct jump up in the percent by year of examination when comparing the data recorded on the revised codesheet compared to the initial codesheet. This is probably a reflection of both the limited coding range employed with the initial codesheet and the fact that the revised codesheet could record up to 10 symptom codes compared to only three on the initial codesheet.

The most frequently reported symptom for each year in the initial VA registry was fatigue, but the most frequently reported symptom across all years in the revised VA registry was joint and muscle pain as seen in the CCEP. The revised VA registry format is structurally closer to the CCEP than the initial codesheet by virtue of the potential number of symptoms that can be recorded. There did not appear to be any trailing off in the frequency of reported symptoms in the later years of the revised VA registry as was observed for the CCEP.

4. DIAGNOSTIC DATA BY CALENDAR YEAR OF EXAM

Table 7 presents the percent distribution of diagnoses by year of examination for the 32,876 persons on the CCEP. Diagnoses are grouped by broad diagnostic categories, and individuals with multiple diagnoses in a single broad category, are counted only once in that category. Unlike the distribution of symptoms by year of exam, the table of diagnoses reported in the CCEP is amazing uniform from year to year. There are no unusual drop in percentages after 1997 for any of the diagnostic categories that would suggest a trailing off in the problems affecting the GWV. The three most frequently recorded diagnoses in the CCEP were diagnoses involving the musculoskeletal system and connective tissue; symptoms, signs, and ill-defined conditions; and mental disorders.

Table 8 presents the percent distributions of broad diagnostic categories by year of examination for diagnoses recorded either in the initial VA (years 1992-1995) or in the revised VA (years 1996-1999). Within any registry system

(initial or revised), the percent reporting a diagnosis in any one category appears to be uniform across the applicable years. As with the symptom table for the VA registry breakdown, an increase in frequency for a particular diagnostic group is seen between those years covered by the initial VA codesheet and those years covered by the revised codesheet. This increase is probably a reflection of the increase from a maximum of 3 diagnoses to a maximum of 10 diagnoses. As with the CCEP diagnostic data, diagnoses involving the musculoskeletal system and connective tissue and mental disorders are among the most frequently reported diagnoses. While the category "Symptoms, Signs and Ill-defined Conditions" is among the top three diagnostic categories in the CCEP, it was almost never used on the initial VA codesheet, and infrequently used on the revised codesheet.

5. DESCRIPTION OF CCEP AND VA OVERLAP GROUP

There were 2,922 persons who were seen in both the CCEP and the VA registry programs. This is approximately 3 % of the combined registry participants included in this project. Table 9 presents the demographic and military characteristics of the overlap group. All of the persons in this overlap group received an examination in the CCEP. Comparing their demographic and military characteristics to that of the entire group of CCEP participants shows that the overlap group closely resembled the larger group of CCEP participants except for the fact that a greater percentage of the overlap group served with the National Guard and Reserves than did the entire group of CCEP registry

participants. This is consistent with the fact that generally National Guard and Reservists would have been eligible for a VA registry examination earlier than someone whose unit component designation was "Active Duty." The other only other area where the overlap group was different than the bigger CCEP group was the fact that a larger proportion of the overlap group served in Saudi Arabia. This is consistent with a greater proportion being National Guard and Reservists who would have been less likely to be sent to Kuwait or Iraq.

Table 10 presents the distribution of symptoms recorded in the examinations of the overlap group. For the symptoms recorded in the CCEP and for the symptoms recorded in the revised VA registry, every symptom category for the overlap group has a higher reporting rate than that seen in Table 2 for the entire population. This would suggest that persons in this overlap group report more symptoms than the average registry participant who obtains only one examination. Table 11 presents the distribution of the diagnoses recorded for the overlap group in the various registry programs in which they participated. As seen before, musculoskeletal system and connective tissue diagnoses and mental disorders are the most frequently recorded diagnoses. Comparison of Table 11 to Table 3 showing the distribution of each of the complete registry populations shows that the rate of reporting of nearly every diagnostic category is higher among the overlap group than among the general registry populations. This group seeking multiple registry examinations does appear to be sicker than other registry participants.

6. VA HEALTH CARE UTILIZATION PATTERNS

The identities of the 100,339 combined registry participants were matched to the VA inpatient and outpatient computer files to identify all inpatient and outpatient visits recorded for these individuals. Of the 100,339 combined registry participants, 11,195 individuals (approximately 11 %) had had one or more VA hospitalizations from October 1, 1990, through September 30, 2001, for a total of 27,078 separate hospitalizations. This rate of hospitalization is considerably higher than the 4.5 % VA hospitalization rate observed for the entire 696,470 Gulf deployed population. Table 12 shows that just under 50 % of this group of hospitalized registry participants were diagnosed with a mental disorder. Approximately one third of the hospitalized registry participants had a diagnosis of musculoskeletal system or connective tissue, and one third had a diagnosis coded to the category of symptoms, signs, and ill-defined conditions. Table 13 shows the percentage distribution of the diagnoses relative to the entire population of registry participants. Over 14 % of the VA registry participants were hospitalized while only 4.3% of the CCEP participants were at some time hospitalized by VA. Eligibility for VA services is the major factor in the difference in these hospitalization rates.

Matching the combined registry individuals to the files of VA outpatient records, identified 77,631 individuals or approximately 77 % of the 100,339 registry participants who had one been seen at the VA one or more times. From October 1, 1990, through September 30, 2001, these 77,631 registry individuals had visited a VA medical facility over 2.2 million times. A VA registry

examination and subsequent laboratory tests and referrals are usually recorded as outpatient visits and would slightly inflate the total number of outpatient visits. However, of those 29,954 combined registry participants who were only examined in the CCEP, 13,293 of them generated a total of 206,375 VA outpatient visits. This represents an average of 15.5 VA visits per person, none of which would have been related to a VA registry examination.

7. VA COMPENSATION PATTERNS

Of the 100,339 combined registry participants, approximately 35% (n=34,669) are receiving compensation for one or more service-connected conditions. Table 14 shows the distribution by diagnostic category among compensated registry participants. Almost 78 % of all those registry participants who are being compensated are being compensated for a condition involving the musculoskeletal system. The next most frequent service-connected disease category were conditions involving the skin (31.2 %). Slightly higher disease category-specific percentages were observed for the CCEP participants compared to the VA Registry participants for almost every diagnostic category. Table 15 shows the percent distribution of service-connected disease categories among all registry participants. A total of approximately 27 % of all registry participants are receiving compensation for a service-connected musculoskeletal disorder.

8. Nested Case-Control Analyses

A second important area of analysis of the combined registry data was to evaluate potential risk factors associated with selected medical conditions. Although registry participants were self-selected, they can provide a pool of potential cases from which to select the cases for further evaluation. For this purpose, the following eight medical conditions were selected for evaluation: post traumatic stress disorder (PTSD) (ICD-9, 309.81), dermatitis (692.9), lumbago (724.2), all cancer combined (140-208), migraine (346), peripheral neuropathy (356.9), chronic obstructive pulmonary disease (COPD) (496), and asthma (493.9). The registry participants who were ever diagnosed with a given condition either on CCEP or VA registry were identified as the cases. All registry participants who did not have the selected condition recorded on any registry were used as controls. The following exposure data were provided by CHPPM: combat MOS (Yes,No) deployed in Iraq or Kuwait (Y.N.), Khamisiyah nerve gas plume exposure (Y.N.)[5], total suspended particulate greater than 260 ug/m^3 (Y.N.). Demographic and military variables included in the analysis as covariates were age (in 1991), sex, race (white/others), branch of service (Army and Marines vs. Navy and Air Force), and unit component (active duty vs. Reserve and National Guard).

Logistic regression modeling produced adjusted odds ratios (ORs) and associated 95% confidence interval (CIs).[6] When the CI of the OR did not include one, the OR was considered statistically significant. The following observations were made:

PTSD: The risk of PTSD was significantly associated with having been deployed in Iraq or Kuwait (OR=1.15;95% CI=1.06-1.25) during Operation Desert Storm and having served in the Army or Marine Corps (OR=1.39;95% CI=1.22-1.60). This is certainly consistent with a hypothesis that the troops who were more likely to have been exposed to combat stress would have a higher risk of PTSD.

Dermatitis: None of the exposure variable were associated with dermatitis.

Lumbago: Older age, non-white race, ground troops, active duty unit service, and being male were all significantly associated with the risk of lumbago or lower back pain.

Cancer: No exposure variable was significantly associated with the risk of cancer. As expected, age (OR=1.06;95% CI=1.05-1.07), and white race (OR-1.66;95% CI=1.36-2.04) were found to be risk factors for cancer. Skin cancer was the most prevalent cancer among the registry participants and the whites have much higher rate of skin cancer than the non-whites. The lower risk of cancer among non-ground troops (Navy and Air Force troops) compared to ground troops (OR=0.69;95% CI=0.54-0.90) requires a further investigation.

Migraine: A small but significantly higher risk of migraine among young active duty unit troops who were under the Khamisiyah nerve gas plume in Saudi Arabia was noted.

Peripheral Neuropathy: None of the variables except for age (OR=1.07; 95% CI=1.05-1.09) was associated with the risk of peripheral neuropathy.

COPD: A surrogate measure of air pollution, i.e., TSP>260 ug/m^3, was significantly associated with the risk of COPD (OR=1.17;95% CI=1.01-1.34). Although cigarette smoking is a major risk factor, other possible causes such as air pollution may act as independent risk factors in its genesis.

Asthma: Unlike COPD, the risk of asthma was not associated with the TSP level.

In summary, the nested case-control analyses provided a few hypotheses for further evaluation: 1) the higher risk of PTSD associated with surrogate measures of combat stress (ground troops, deployment in Iraq or Kuwait theater of operations); 2) the higher risk of migraine among those troops located under the Khamisiyah nerve gas plume; and 3) the higher risk of respiratory problem (COPD) among troops exposed to higher level of sand particulates.

9. Evaluation of Spouse and Family Data

In addition to concerns about the health of the military personnel who served in the Persian Gulf Theater, there were concerns about the health problems of spouses and children who might have suffered an illness following exposure to the veterans returning from the Gulf. In order to fulfill the legislative mandate in Public Law 103-446, the VA Funded Examination Program for the Spouses and Children of Persian Gulf Veterans Program was established on April 1, 1996. Eligibility for the program required that the Gulf veteran had completed a VA Persian Gulf Registry Examination. Family units were assigned to a coordinating VA medical center that made arrangements for the examinations of the spouses and children to be conducted at their university affiliated medical facilities according to strict protocol guidelines. Data collected in these examinations was entered into the Persian Gulf War Spouses and Children Registry database (SPCR).

In the VA PGR reviewed for this report, there are 424 veterans who had some data on family members in the VA SPCR. This included 754 records: 285 spouses and 469 children. The family unit for any veteran could include a spouse only, a child only, or both a spouse and children. Table 19 presents the distribution of selected characteristics for these family members. The mean age of the spouses at time of examination was 37 years, and the mean age of the children was 7 years of age. Over 80 % of the children were either of preschool or elementary school age. Approximately two thirds of the spouses and one half of the children were white. Among those family units with both an index veteran

and a spouse (N=285), less than 4 % of the spouses were male. The sex ratio of the children represented was .95 (males to females). Eighty percent of the spouses reported having some contact with military equipment brought back from the Gulf War by their index veteran. A similar percentage reported that they believed that their health problems were related to their veterans' Gulf War service.

Table 20 shows the percent distribution for the 5 levels of self-reported health status for the index veterans, their spouses, and children. Over 40 percent of the index veterans reported their health status as "poor" or "very poor." This cohort of Gulf veterans who elected along with their families to participate in the VA SPCR appeared to have more severe health problems than the entire population of Gulf registry participants of which less than 28 % reported their health status as "poor" or "very poor." The group of 285 spouses in the SPCR thought themselves to be in better health than the index veterans with only 28 % of them reporting their health as "poor" or "very poor." The children appeared to be the healthiest group. The health status of more than 55% of the children in the SPCR was "good" or "very good", and less than 15 % were in "poor" or "very poor" health.

The distribution of reported symptoms among the participants of the VA SPCR along with those of the index veterans are shown in Table 21. Examination protocols for the spouses and children in this program allow for the recording of up to 10 symptoms or complaints. Of the 424 index veterans described, 307 of them were examined while the initial PGR codesheet format

was used, and a maximum of three symptoms were recorded in the database. The data for the other 117 index veterans were recorded on the revised PGR codesheets, and up to 10 symptoms could be recorded. Because of this difference in the data recorded for the index veterans, the distributions for the symptoms for the index veterans in Table 21 are presented separately for the initial and revised groups. As seen in the review of the entire PGR data, frequency distributions for the most common symptoms are always higher among those groups with the opportunity for a maximum of 10 symptoms as opposed to only 3 symptoms. The frequency distribution of the symptoms in the "Revised" group of index veterans can be directly compared to the distributions of the spouses and children. If hazardous Gulf exposures had been transferred from the index veteran to their spouses and children, one would expect to see comparable patterns of elevated prevalence of specific symptoms across the three groups. Those common patterns were not observed in the SPCR. The index veteran had considerably higher rates of all the symptoms listed, particularly for fatigue (31 %), headaches (32 %), joint/muscle pain (41 %) and memory problems (38 %). The distribution observed for the spouses showed approximately 24 % reporting headaches and 17 % reporting fatigue while only 9 % reported joint/muscle pain and 4% reported memory problems. As expected, the children had less of each symptom compared to the spouses except for rashes, a common childhood ailment.

Table 22 presents the distributions of the diagnoses for the two index veteran groups, the spouses, and the children by major diagnostic categories.

As with Table 21, the distributions of the spouses and children should be compared only with those of the index veterans in the "Revised" group. Except for diagnoses involving the respiratory and genitourinary systems, the frequency patterns of diagnoses by broad diagnostic categories for the index veterans in the "Revised" group and for the spouses were quite similar. The relatively low percents among the children for most categories support the observation that this group had a very high proportion whose general health status was "good" or "very good." The most frequent diagnoses among children were for diagnoses of the respiratory system reflecting the typically high prevalence of childhood asthma.

Tables 20, 21, and 22 compare overall patterns of the index veterans to those of the spouses and children, but do not address the actual relationship of illness among family members of the same family unit. In an effort to address the pattern of illness within family units, three health categories were selected. These included diagnoses of infectious and parasitic diseases and diagnoses of mental disorders as well as the reporting of a symptom of a rash. It was thought that these categories would most likely demonstrate transmission of a health condition from a veteran to a family member if that has occurred. For each condition, those family units in which the index veteran had that condition were examined for similar health problems among the spouse and children. The agreement or "matching" ratios observed between the spouse and veteran and between the children and the veteran are presented in Table 23 as the ratio of the number of spouses or children with that condition over the total number of

family units examined for that condition. By definition, the index veteran of each family unit examined would have the specific health problem. Among the family units of the 28 veterans with infectious or parasitic diseases, none of their spouses or children were diagnosed with a similar condition. Among the family units of the 83 index veterans with mental disorders, one spouse and no children were diagnosed with mental disorders. Finally, among the family units of the 98 veterans with rashes, 12 spouses and 31 children complained of having rashes. By examining the patterns of these three health conditions among the family units in which the index veteran suffered with the condition, no significant patterns of transmission of illness within family units could be demonstrated.

In conclusion, examining the patterns of illness among family units that included an index veteran who served in the Gulf theater did not demonstrate any similarities between health problems observed among the veterans and those observed among their spouses and children. No significant transmission of disease within specific family units could be detected by examining three conditions that were commonly reported by the Gulf veterans and in which one might expect some transmission to be easily demonstrated if it existed.

III. KEY RESEARCH ACCOMPLISHMENTS

- The merging of clinical data from the CCEP and the VA PGR, military and demographic data from the DMDC roster files, DoD and VA hospitalization files, CHPPM exposure data files (anthrax, Khamisiyah plume model, GIS, sand particle exposure) and VA compensation files has been completed and the combined files are available for future use.

- Distribution of symptoms and diagnoses among the registry participants has not changed significantly over time (1993-1999).

- The rate of hospitalization in a VA hospital was considerably higher among the registry participants than the entire Gulf War veterans (11% vs. 4.5%).

- The proportion of veterans receiving compensation for service connected medical conditions was higher among the registry participants than the entire Gulf War veterans (35% vs. 22%).

- The nested case-control analyses suggested a few hypotheses for further evaluation:

    1) PTSD and surrogate measures of combat stress
    2) Migraine and potential exposure to nerve gas based on the Khamisiyah plume model; and

3) COPD and exposure to sand particles.

- The VA Persian Gulf War Spouse and Children Registry database was utilized to evaluate the possible transmission of disease from Gulf veteran to their families. Examining the patterns of illness among 424 family units that included a Gulf veteran registry participant did not demonstrate any similarities between health problems of the veterans and those of the spouses and children. No evidence of transmission of a veteran's disease within family units was detected by examining the health of family units in which the index veteran suffered from one of three health conditions common to Gulf veterans.

IV. REPORTABLE OUTCOMES

- Hyams, C. Combined analysis of VA/DoD Gulf War registries: A study of clinical findings from systematic medical examinations of 100,000 U. S. Gulf War veterans. Presented at the Second Annual Plenary Session, Military and Veterans Health Coordinating Board, Rockville, MD, December 10-12, 2001.
- Dalager, N. Combined Analysis of the VA and DoD Gulf War Clinical Registries. Presented at the First Annual Military and Veterans Health Coordinating Board Meeting, Andrews Air Force Base, MD, September 2000.

V. CONCLUSIONS

As of September 1999, a total of 100,339 unique Gulf War veterans participated in the clinical evaluation programs initiated by VA and DOD. Both VA and DoD registry participants reported a broad range of symptoms that span a variety of organ systems. Among the most commonly reported symptoms in both registries are fatigue, joint/muscle pain, and headaches. The patterns of symptom reporting have not changed significantly over time (1993-1999). The most common diagnostic categories in the VA registry are the same as in the DOD CCEP: musculoskeletal system diseases and mental disorders. As with symptoms, the diagnoses do not cluster in a single organ system.

The rate of hospitalization among the registry participants is considerably higher than the rate observed for the entire Gulf War veterans (11% vs. 4.5%). Approximately 35% of the registry participants are receiving compensation for one or more service connected conditions, while the comparable rate for the entire Gulf veteran is 22 %. The nested case-control analyses suggested a few hypotheses for further evaluation. They are 1) PTSD and combat stress, 2) migraine and Khamisiyah plume exposure and 3) COPD and exposure to sand particulates.

Utilizing the VA Gulf SPCR database, patterns of illness among Gulf veterans were compared to those of their spouse and children. Among 424 family units, no common patterns of illness could be detected, and no evidence

of transmission of common health problems appeared to exist between veterans and their family members.

VI. REFERENCES

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Figure 1:

Combined Registry Database

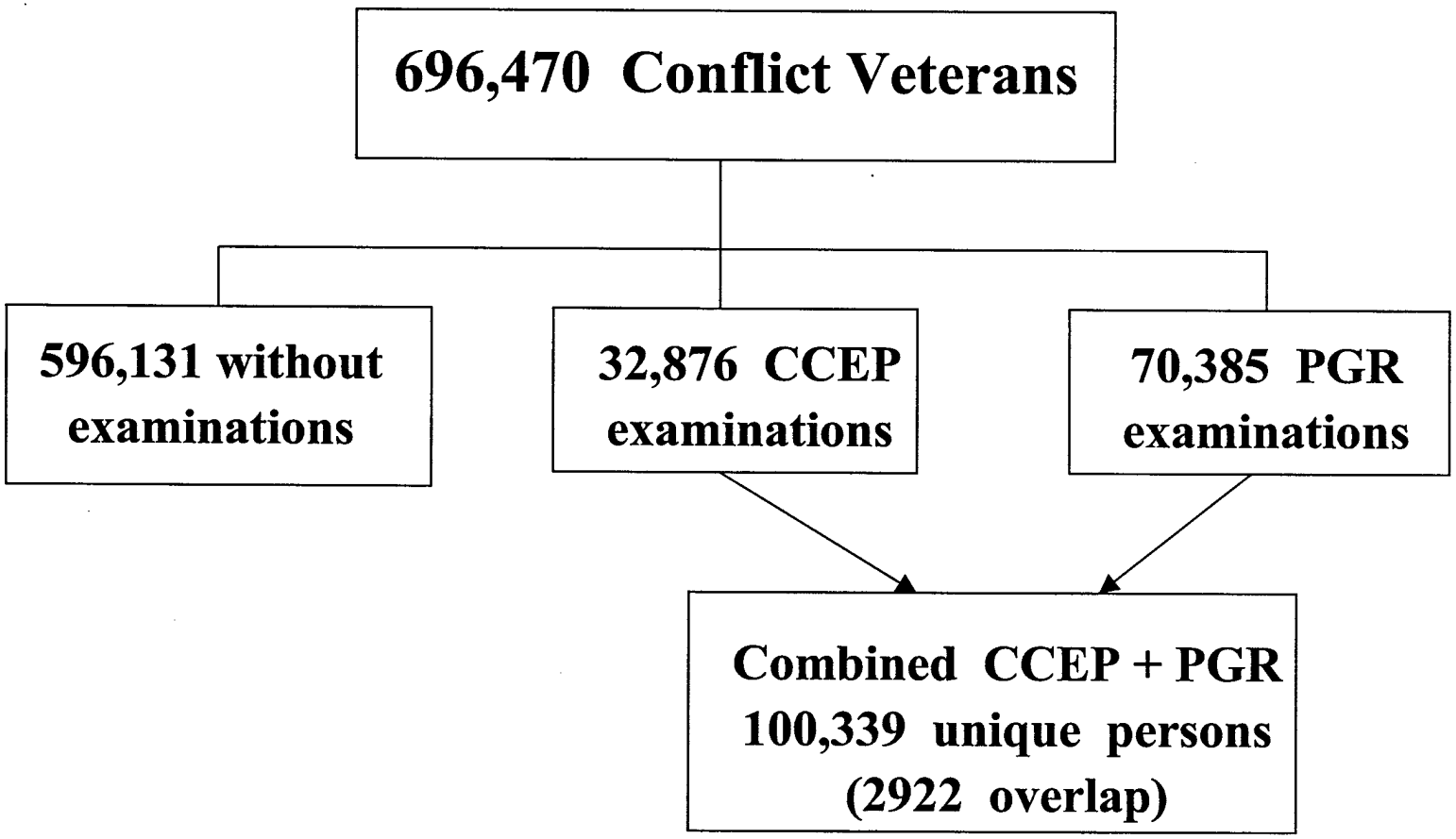

Table 1: Percent Distribution of Selected Characteristics for All 100,339 Combined Gulf Registry Participants by Registry Category

Characteristic[a]	CCEP (N=32,876)	Initial VA (N=49,079)	Revised VA (N=21,306)
	%	%	%
Age (1991)			
<25	23.6	34.9	39.6
25-34	50.0	35.4	36.6
35-44	23.2	21.9	19.5
45.54	2.8	6.6	3.8
55-64	0.2	0.8	0.3
>=65	0.0	0.0	0.0
Unknown	0.2	0.3	0.3
Race			
White	56.1	66.8	62.8
Black/Other	43.7	32.9	36.9
Unknown	0.2	0.3	0.3
Sex			
Male	89.7	89.5	90.4
Female	10.2	10.3	9.4
Unknown	0.1	0.3	0.2
Branch			
Air Force	6.2	6.1	6.7
Army	84.9	73.8	70.7
Coast Guard	0.1	0.3	0.1
Marine	5.0	13.0	13.3
Navy	3.8	6.8	9.2
Unit Component			
Active	90.7	57.1	76.1
National Guard	4.6	20.4	9.7
Reserve	4.6	22.5	14.2
Time in Theater			
Left Before D. Storm	1.7	2.0	2.4
Present In D. Storm	94.1	91.3	91.8
Arrived After D. Storm	3.5	6.6	5.8
Unknown	0.7	0.0	0.0

[a] Data for the following characteristics were provided by CHPPM: place in theater, combat MOSC, Khamisiyah, and TSP>260 ug/m^3

Percent Distribution of Selected Characteristics for All 100,339 Combined Gulf Registry Participants by Registry Category (Continued)

Characteristic[a]	CCEP (N=32,876)	Initial VA (N=49,079)	Revised VA (N=21,306)
	%	%	%
Place in Theater			
Land only	70.2	68.6	66.6
Land/Water	20.5	19.8	20.6
Water	0.6	1.5	2.3
Unknown	8.7	10.1	10.5
Iraq/Kuwait	58.8	44.7	50.1
Saudi only	31.9	43.7	37.1
Combat MOSC			
Yes	13.8	12.1	12.0
No	86.2	87.9	88.0
Khamisiyah			
Yes	28.0	23.2	23.9
No	72.0	76.8	76.1
TSP > 260[b]			
Yes	40.4	42.5	41.1
No	45.3	41.3	41.6
Unknown	14.3	16.2	17.3

[a] Data for the following characteristics were provided by CHPPM: place in theater, combat MOSC, Khamisiyah, and TSP>260 ug/m^3

[b] TSP = Total suspended particulates exposure > 260 ug/m^3

Table 2: **Percent Distribution of Symptoms Recorded for All† Persons Who Were Examined in Either the DoD CCEP or the VA Gulf Registry Programs**

Symptom Category	CCEP N=32,876 %	Initial VA N=49,079 %	Revised VA N=21,306 %
Abdominal Pain	20.8	2.7	4.6
Diarrhea	25.5	4.6	14.0
Fatigue	46.6	21.0	24.1
Headache	40.8	18.3	27.9
Joint/Muscle Pain	51.8	16.2	39.2
Memory Problem	36.2	14.2	24.1
Rash	30.0	18.5	25.3
Shortness of Breath	23.0	8.0	10.2
Sleep Disturbance	35.9	5.6	13.5
Weight Control	17.1	1.5	2.6

† Data includes 2,922 persons examined in both the CCEP and VA registry programs.

Table 3: Percent Distribution of Diagnoses Recorded for All† Persons Who Were Examined in the DoD CCEP and the VA Gulf Registry Programs

Diagnostic Category	CCEP N=32,876 %	Initial VA N=49,079 %	Revised VA N=21,306 %
Infectious and Parasitic Disease	8.8	6.8	8.6
Malignant Neoplasms	0.6	0.4	0.8
Endocrine, Nutritional, Metabolic, Immunity	8.6	5.5	9.0
Blood and Blood-Forming Organs	3.0	1.5	2.4
Mental Disorders	35.2	13.5	27.1
Nervous System and Sense Organs	16.9	7.8	15.4
Circulatory System	8.3	6.7	10.0
Respiratory System	16.1	13.1	16.1
Digestive System	20.1	10.6	15.4
Genitourinary System	5.4	3.2	5.4
Skin and Subcutaneous Tissue	19.1	12.5	17.3
Musculoskeletal System and Connective Tissue	50.1	22.3	30.4
Symptoms, Signs, and Ill-Defined Conditions	42.2	3.0	12.3
Injury and Poisoning	3.5	4.3	4.3

† Data includes 2,922 persons examined in both the CCEP and VA registry programs.

Table 4: Percent Distribution of Selected Self-Reported Exposures for Gulf Registry Participants by Registry[a]

Self–Reported Exposure	CCEP (N=32,876) %	Revised VA (N=21,306) %
Diesel/Other Petro Fumes		
Yes	77.6	90.9
No[b]	22.4	9.1
Passive Smoking		
Yes	73.8	89.1
No	26.2	10.9
Skin Exposure to Fuel		
Yes	NA	74.8
No		25.2
Burning Trash/Feces		
Yes	NA	77.3
No		22.7
Smoke From Oil Fires		
Yes	61.0	75.5
No	39.0	24.5
Ate non-Mil. Issued Food		
Yes	57.0	70.1
No	43.0	29.9
Pesticides		
Yes	58.4	68.5
No	41.6	31.5
Smoke from Tent Heaters		
Yes	60.5	70.6
No	39.5	29.4
Pyridostigmine		
Yes	68.2	69.4
No	31.8	30.6

[a] The initial VA registry codesheet did not include these categories of self-reported exposures.

[b] Non-responses are assumed to be a "no".

Percent Distribution of Selected Self-Reported Exposures for Gulf Registry Participants by Registry[a] (Continued)

Self–Reported Exposure	CCEP (N=32,876) %	Revised VA (N=21,306) %
Paints and Solvents NOS		
Yes	48.5	53.7
No	51.5	46.3
Anthrax Vaccine		
Yes	42.7	69.4
No	57.3	30.6
CARC paint		
Yes	38.8	36.5
No	61.2	63.5
Microwaves		
Yes	25.0	32.8
No	75.0	67.2
Ate/Drank Contaminated Food		
Yes	20.3	35.3
No	79.7	64.7
Bathed in non-Mil. Issued Water		
Yes	26.1	29.9
No	73.9	70.1

[a] The initial VA registry codesheet did not include these categories of self-reported exposures.

Figure 2. Number of Participants Entering the Gulf Registries by Calendar Year

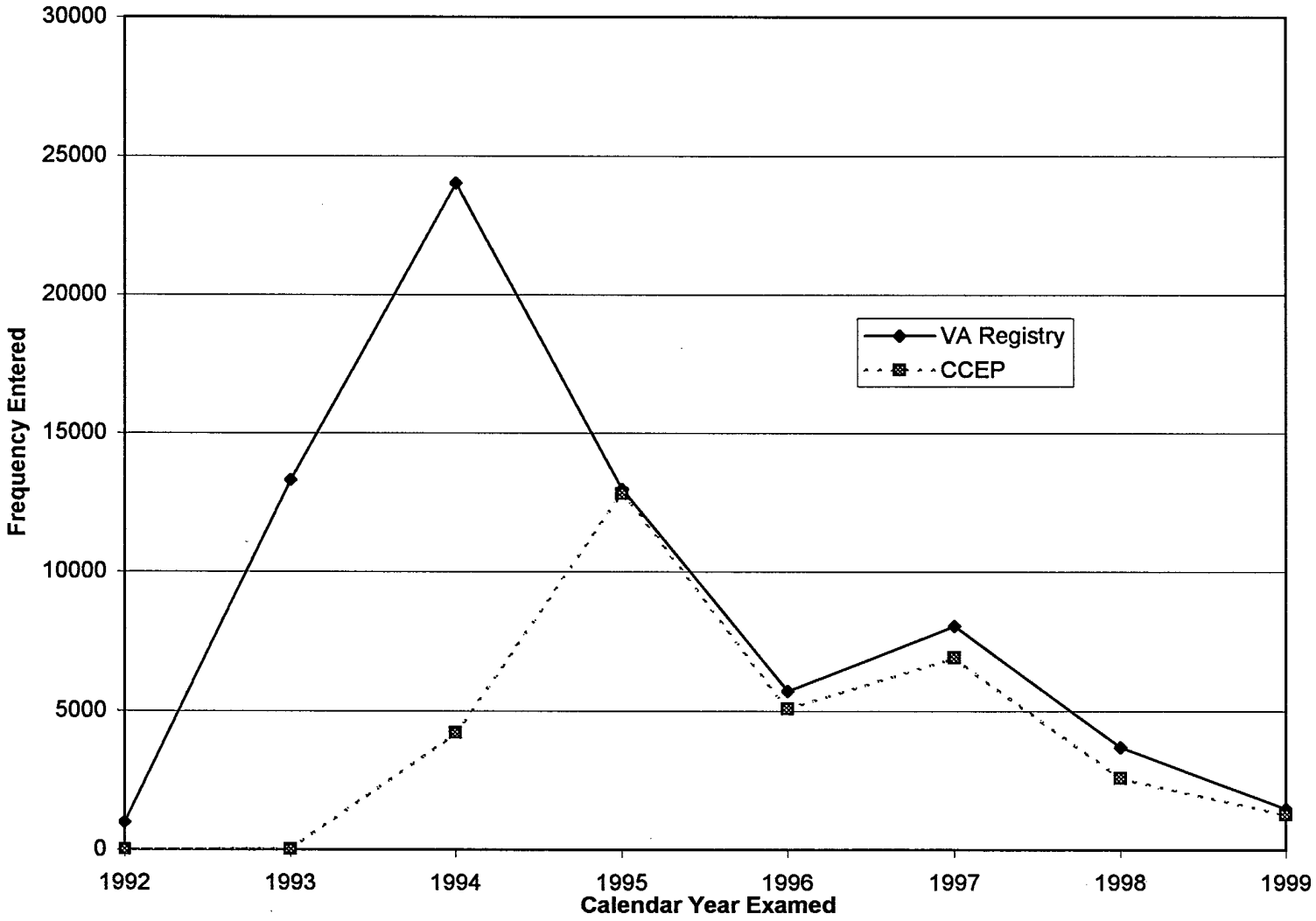

Table 5: **Percent Distribution of Symptoms Recorded for Conflict Veterans in the CCEP by Year of Examination**

Symptom Category	Exam Year 1993 %	1994 %	1995 %	1996 %	1997 %	1998 %	1999 %	All Years
Abdominal Pain	27.3	19.0	15.0	29.1	35.9	2.1	9.1	20.8
Diarrhea	9.1	22.3	16.3	36.3	47.9	2.5	10.6	25.5
Fatigue	27.3	51.8	41.4	58.0	65.5	4.9	18.8	46.6
Headache	45.5	41.8	35.2	53.0	60.1	4.2	15.5	40.8
Joint/Muscle Pain	45.5	52.9	49.1	64.5	70.1	5.1	19.7	51.8
Memory Problem	36.4	37.1	31.3	46.0	53.9	3.8	14.2	36.2
Rash	27.3	29.9	26.9	37.9	43.3	3.0	12.9	30.0
Shortness of Breath	9.1	12.8	18.7	32.9	40.2	1.9	10.5	23.0
Sleep Disturbance	9.1	35.8	13.0	45.6	53.6	3.7	15.2	35.9
Weight Control	0.0	8.2	6.2	26.8	43.0	1.4	9.1	17.1
Total Persons by Exam Year	11	4214	12804	5075	6920	2583	1269	32876

Table 6: Percent Distribution of Symptoms Recorded for Conflict Veterans in the VA Registry by Year of Examination

Symptoms Category	Exam Year: Initial VA Registry 1992 %	1993 %	1994 %	1995 %	Revised VA Registry 1996 %	1997 %	1998 %	1999 %
Abdominal Pain	3.4	2.4	2.8	2.8	4.3	4.7	4.7	4.8
Diarrhea	10.6	7.8	9.1	9.4	13.8	14.5	13.9	12.7
Fatigue	20.2	16.6	22.7	22.4	24.3	24.0	21.9	25.2
Headache	16.2	13.4	19.8	21.2	28.2	28.5	26.6	25.9
Joint/Muscle Pain	11.9	13.8	17.7	16.6	37.3	39.1	39.8	41.8
Memory Problem	11.5	10.7	15.2	16.7	21.4	26.0	24.7	24.3
Rash	14.7	16.1	20.0	18.5	24.3	25.5	25.3	23.6
Shortness of Breath	8.2	7.6	8.1	8.3	9.8	10.1	9.8	10.4
Sleep Disturbance	4.9	4.7	5.7	6.7	12.5	13.5	15.3	14.3
Weight Control	2.7	1.4	1.6	1.3	2.2	2.4	2.8	2.9
Total Persons by Exam Year	1000	13262	23778	10953	5672	8050	3709	1485

Table 7: **Percent Distribution of Diagnoses Recorded for Conflict Veterans in the CCEP by Year of Examination**

Diagnostic Category	Exam Year 1993 %	1994 %	1995 %	1996 %	1997 %	1998 %	1999 %	All Years %
Infectious and Parasitic Disease	18.2	7.8	9.2	9.1	8.6	8.9	8.4	8.8
Malignant Neoplasms	0.0	0.6	0.4	0.7	0.7	0.9	1.4	0.6
Endocrine, Nutritional, Metabolic, Immunity	9.1	7.5	8.1	8.4	9.0	10.8	10.1	8.6
Blood and Blood-Forming Organs	9.1	2.7	3.3	2.5	2.9	3.8	3.2	3.0
Mental Disorders	18.2	35.3	35.8	39.1	33.9	30.2	29.2	35.2
Nervous System and Sense Organs	27.3	16.3	18.1	17.6	15.3	16.3	14.5	16.9
Circulatory System	0.0	7.0	8.1	8.8	8.6	8.9	10.5	8.3
Respiratory System	18.2	15.1	18.1	16.4	14.2	12.5	16.5	16.1
Digestive System	9.1	21.6	19.6	22.6	19.5	18.5	16.9	20.1
Genitourinary System	9.1	4.8	5.5	5.4	5.3	5.4	5.7	5.4
Skin and Subcutaneous Tissue	27.3	17.8	20.5	20.2	17.6	17.7	15.5	19.1
Musculoskeletal System and Connective Tissue	54.5	45.6	48.9	51.9	52.1	52.7	53.7	50.1
Symptoms, Signs, and Ill-Defined Conditions	45.5	46.8	41.8	36.9	43.6	43.4	42.9	42.2
Injury and Poisoning	0.0	2.6	3.4	3.8	3.6	4.5	2.7	3.5
Total Persons by Exam Year	11	4214	12804	5075	6920	2583	1269	32876

Table 8: Percent Distribution of Diagnoses Recorded for Conflict Veterans in the Initial VA Registry by Year of Examination

	Exam Year							
	Initial VA Registry				Revised VA Registry			
Diagnostic Category	1992 %	1993 %	1994 %	1995 %	1996 %	1997 %	1998 %	1999 %
Infectious and Parasitic Disease	7.7	7.0	7.0	6.1	8.6	8.3	8.8	7.5
Malignant Neoplasms	0.1	0.4	0.4	0.4	0.7	0.8	1.0	0.8
Endocrine, Nutritional, Metabolic, Immunity	4.9	5.2	5.5	6.1	7.9	8.1	10.9	10.8
Blood and Blood-Forming Organs	2.2	1.3	1.6	1.5	2.5	2.3	2.1	2.2
Mental Disorders	13.2	12.3	13.8	14.5	26.1	27.5	26.9	28.1
Nervous System and Sense Organs	7.3	7.6	7.7	8.6	15.1	15.1	15.8	16.5
Circulatory System	6.0	6.4	6.6	7.3	9.4	9.5	10.8	11.6
Respiratory System	18.4	13.5	13.1	12.5	16.4	16.0	15.2	16.0
Digestive System	13.4	10.0	10.7	10.8	14.9	15.0	16.1	15.3
Genitourinary System	3.0	3.1	3.3	3.2	5.6	5.1	5.1	6.2
Skin and Subcutaneous Tissue	13.1	12.2	13.0	11.8	16.6	17.0	16.4	16.5
Musculoskeletal System and Connective Tissue	24.2	20.7	22.2	24.5	28.9	30.8	29.0	35.8
Symptoms, Signs, and Ill-Defined Conditions	1.9	2.5	3.0	3.9	9.9	12.5	15.4	16.0
Injury and Poisoning	5.3	5.4	4.0	3.6	4.3	4.1	4.2	4.8
Total Persons by Exam Year	1000	13262	23778	10953	5672	8050	3709	1485

Table 9: Percent Distribution of Selected Characteristics for Persons Participating in Both the CCEP and VA Gulf Registry Programs

Characteristic[a]	CCEP/VA Overlap (N=2,922)
	%
Age (1991)	
<25	17.4
25-34	37.2
35-44	35.2
45.54	9.0
55-64	0.9
>=65	0.0
Unknown	0.3
Race	
White	58.9
Black/Other	40.8
Unknown	0.3
Sex	
Male	86.6
Female	13.2
Unknown	0.2
Branch	
Air Force	6.9
Army	84.3
Coast Guard	0.1
Marine	4.6
Navy	4.1
Unit Component	
Active	64.4
National Guard	20.6
Reserve	15.0
Time in Theater	
Left Before D. Storm	1.6
Present In D. Storm	92.7
Arrived After D. Storm	5.2
Unknown	0.6

[a] Data for the following characteristics were provided by CHPPM: place in theater, combat MOSC, Khamisiyah, and TSP>260 ug/m^3

Percent Distribution of Selected Characteristics for Persons Participating in Both the CCEP and VA Gulf Registry Programs (Continued)

Characteristic[a]	CCEP/VA Overlap (N=2,922)
	%
Place in Theater	
Land only	69.6
Land/Water	21.6
Water	0.4
Unknown	8.4
Iraq/Kuwait	48.1
Saudi only	43.1
Combat MOSC	
Yes	13.6
No	86.5
Khamisiyah	
Yes	28.0
No	72.0
TSP>260[b]	
Yes	41.7
No	45.3
Unknown	13.0

[a] Data for the following characteristics were provided by CHPPM: place in theater, combat MOSC, Khamisiyah, and TSP>260 ug/m^3

[b] TSP = Total suspended particulates exposure > 260 ug/m^3

Table 10: **Percent Distribution of Symptoms Recorded for the 2,922 Persons Who Were Examined in Both the DoD CCEP and the VA Gulf Registry Programs**

Symptom Category	CCEP %	Initial VA %	Revised VA %
Abdominal Pain	27.9	2.1	6.0
Diarrhea	31.2	3.8	17.1
Fatigue	57.5	21.7	29.0
Headache	49.1	20.3	34.5
Joint/Muscle Pain	61.1	16.1	53.2
Memory Problem	48.0	16.8	32.9
Rash	39.3	19.6	28.5
Shortness of Breath	29.1	8.5	13.5
Sleep Disturbance	47.2	8.3	17.8
Weight Control	21.3	1.1	2.1
Total Persons	2922	1593	1329

Table 11: Percent Distribution of Diagnoses Recorded for the 2,922 Persons Who Were Examined in Both DoD CCEP and the VA Gulf Registry Programs

Diagnostic Category	CCEP %	Initial VA %	Revised VA %
Infectious and Parasitic Disease	10.3	7.3	10.4
Malignant Neoplasms	1.0	0.8	1.1
Endocrine, Nutritional, Metabolic, Immunity	10.6	6.7	9.9
Blood and Blood-Forming Organs	3.5	1.8	2.3
Mental Disorders	46.9	15.8	33.6
Nervous System and Sense Organs	21.4	9.6	22.9
Circulatory System	10.3	7.7	13.5
Respiratory System	20.3	15.8	18.7
Digestive System	26.9	11.0	20.4
Genitourinary System	5.7	3.3	7.7
Skin and Subcutaneous Tissue	21.1	13.2	20.4
Musculoskeletal System and Connective Tissue	54.9	26.6	45.8
Symptoms, Signs, and Ill-Defined Conditions	46.7	2.7	12.4
Injury and Poisoning	2.7	4.5	7.1
Total Persons	2922	1593	1329

Table 12: Percent Distribution of Diagnoses from VA Inpatient Records of 11,195 Registry Participants Who Were Hospitalized

Diagnostic Category	CCEP %	VA Registry %	All Hospitalized Registry Participants %
Infectious and Parasitic Disease	12.0	13.2	12.9
Malignant Neoplasms	3.3	2.6	19.6
Endocrine, Nutritional, Metabolic, Immunity	21.9	19.6	19.6
Blood and Blood-Forming Organs	6.1	6.5	6.3
Mental Disorders	46.0	49.4	48.8
Nervous System and Sense Organs	18.0	16.9	16.8
Circulatory System	27.3	24.2	24.4
Respiratory System	18.4	21.7	21.2
Digestive System	27.8	30.3	29.9
Genitourinary System	12.6	12.6	12.5
Skin and Subcutaneous Tissue	7.4	10.7	10.3
Musculoskeletal System and Connective Tissue	35.1	31.3	31.3
Symptoms, Signs, and Ill-Defined Conditions	35.1	35.2	34.9
Injury and Poisoning	12.9	16.2	15.8
Total Registrants Hospitalized at VA	1414	10285	11195

Table 13: Percent Distribution by Diagnostic Category of VA Hospitalized Gulf Registry Participants Among All Registry Participants

Diagnostic Category	CCEP %	VA Registry %	All Hospitalized Registry Participants %
Infectious and Parasitic Disease	0.5	1.9	1.4
Malignant Neoplasms	0.1	0.4	0.3
Endocrine, Nutritional, Metabolic, Immunity	0.9	2.9	2.2
Blood and Blood-Forming Organs	0.3	0.9	0.7
Mental Disorders	2.0	7.2	5.4
Nervous System and Sense Organs	0.8	2.5	1.9
Circulatory System	1.2	3.5	2.7
Respiratory System	0.8	3.2	2.4
Digestive System	1.2	4.4	3.3
Genitourinary System	0.5	1.8	1.4
Skin and Subcutaneous Tissue	0.3	1.6	1.1
Musculoskeletal System and Connective Tissue	1.5	4.6	3.5
Symptoms, Signs, and Ill-Defined Conditions	1.5	5.1	3.9
Injury and Poisoning	0.6	2.4	1.8
Total Registrants	32876	70385	100339

Table 14: Distribution of Service-Connected Diagnoses Among Gulf War Veterans Participating in the DOD or VA Registry Programs and Receiving VA Compensation

Service-Connected Disease Category	CCEP %	VA Registry %	All Compensated Reg. Participants %
Musculoskeletal System	86.7	74.3	77.9
Eye	5.6	3.9	4.4
Impairment of Auditory Acuity	22.8	18.7	19.8
Infectious, Immune, & Nutritional Disorders	1.8	1.3	1.3
Respiratory System	24.2	16.8	18.7
Cardiovascular System	19.2	12.9	14.7
Digestive System	28.7	19.0	21.6
Genitourinary System	6.9	5.0	5.6
Gynecological Conditions	3.6	2.4	2.8
Hemic & Lymphatic Systems	1.1	0.8	0.9
Skin	34.7	29.8	31.2
Endocrine System	4.3	2.3	2.9
Neurological Conditions	25.7	22.6	23.1
Mental Disorders	18.1	18.8	18.0
Dental and Oral Conditions	1.6	1.3	1.4
Others	0.1	0.1	0.1
Total Compensated Registry Participants	11016	25456	34669

Table 15: Distribution of Service-Connected Diagnoses of Gulf War Registry Participants Receiving VA Compensation Among all Registry Participants

Service-Connected Disease Category	CCEP %	VA Registry %	All Compensated Reg. Participants %
Musculoskeletal System	29.0	26.9	26.9
Eye	1.9	1.4	1.5
Impairment of Auditory Acuity	7.6	6.8	6.9
Infectious, Immune, & Nutritional Disorders	0.6	0.5	0.5
Respiratory System	8.1	6.1	6.5
Cardiovascular System	6.4	4.7	5.1
Digestive System	9.6	6.9	7.5
Genitourinary System	2.3	1.8	1.9
Gynecological Conditions	1.2	0.9	1.0
Hemic & Lymphatic Systems	0.4	0.3	0.3
Skin	11.6	10.8	10.8
Endocrine System	1.4	0.8	1.0
Neurological Conditions	8.6	8.2	8.0
Mental Disorders	6.1	6.8	6.2
Dental and Oral Conditions	0.5	0.5	0.5
Others	0.0	0.0	0.0
Total Registry Participants	32876	70385	100339

Table 16: Cases Identified with Selected Diagnoses for Case-Control Analyses Among Combined Registry Participants

Diagnosis (ICD Code)	Number
PTSD (303.81)	3179
Dermatitis (692.9)	3115
Lumbago (724.2)	4619
All Cancers (140-208)	504
Migraine (346)	4210
Peripheral Neuropathy (356.9)	147
COPD (496)	876
Asthma (493.9)	2937

Table 17: Odds Ratios for Selected Diagnoses Associated with Covariates Derived from a Logistic Regression Model (Part I)

Covariate	PTSD	Dermatitis	Lumbago	Cancer
	O.R. (95%C.I.) †	O.R. (95%C.I.) †	O.R. (95%C.I.) †	O.R. (95%C.I.) †
Age in 1991 (years)	1.00 (1.00 – 1.01)	1.01 (1.00 – 1.01)*	1.01 (1.01 – 1.02)*	1.06 (1.05 – 1.07)*
Combat MOS	1.07 (0.96 – 1.19)	1.00 (0.89 – 1.11)	1.07 (0.98 – 1.16)	1.01 (0.77 – 1.26)
Iraq or Kuwait Duty	1.15 (1.06 – 1.25)*	1.07 (0.98 – 1.16)	1.05 (0.98 – 1.13)	0.99 (0.79 – 1.23)
Khamisiyah	0.95 (0.87 – 1.03)	0.97 (0.89 – 1.06)	1.05 (0.93 – 1.13)	1.03 (0.83 – 1.30)
TSP>260	0.99 (0.92 – 1.07)	1.01 (0.94 – 1.09)	0.98 (0.92 – 1.05)	1.07 (0.89 – 1.27)
White Race	0.87 (0.81 – 0.93)*	0.90 (0.84 – 0.97)*	0.72 (0.68 – 0.77)*	1.66 (1.36 – 2.04)*
Army or Marine Service	1.39 (1.22 – 1.60)*	0.95 (0.85 – 1.08)	1.59 (1.41 – 1.79)*	0.69 (0.54 – 0.90)*
Active Duty Service	0.93 (0.85 – 1.01)	0.95 (0.87 – 1.03)	1.81 (1.67 – 1.97)*	1.24 (1.00 – 1.51)
Female Sex	0.86 (0.76 – 0.98)*	0.95 (0.84 – 1.07)	0.74 (0.66 – 0.83)*	1.27 (0.96 – 1.64)

*p<.05

† Odds ratio and 95% confidence intervals

Table 18: Odds Ratios for Selected Diagnoses Associated with Covariates Derived from a Logistic Regression Model (Part II)

Covariate	Migraine	Peripheral Neuropathy	COPD	Asthma
	O.R. (95%C.I.) †	O.R. (95%C.I.) †	O.R. (95%C.I.) †	O.R. (95%C.I.) †
Age in 1991 (years)	0.99 (0.99 – 0.99)*	1.07 (1.05 – 1.09)*	1.06 (1.05– 1.06)*	0.99 (0.99 – 1.00)*
Combat MOS	1.05 (0.96 – 1.16)	0.65 (0.36 – 1.18)	1.10 (0.91 – 1.34)	1.04 (0.93 – 1.16)
Iraq or Kuwait Duty	0.90 (0.84 – 0.97)*	0.73 (0.50 – 1.08)	1.06 (0.91 – 1.24)	0.93 (0.85 – 1.01)
Khamisiyah	1.09 (1.02 – 1.18)*	1.01 (0.68 – 1.51)	0.92 (0.78 – 1.08)	0.90 (0.82 – 0.99)*
TSP>260	0.97 (0.91 – 1.04)	0.97 (0.69 – 1.36)	1.17 (1.01 – 1.34)*	0.99 (0.92 – 1.07)
White Race	0.97 (0.91 – 1.03)	1.17 (0.83 – 1.66)	1.68 (1.44 - 1.96)*	1.02 (0.94 – 1.10)
Army or Marine Service	1.04 (0.94 – 1.15)	0.94 (0.59 – 1.51)	1.25 (0.99 – 1.56)	1.14 (1.01 – 1.29)*
Active Duty Service	2.03 (1.85 – 2.21)*	1.35 (0.91 – 2.01)	0.69 (0.59 – 0.80)*	1.65 (1.49 – 1.83)*
Female Sex	2.67 (2.46 – 2.89)*	0.75 (0.40 – 1.39)	0.80 (0.62 – 1.03)	1.58 (1.43 – 1.78)*

*p<.05

† Odds ratio and 95% confidence intervals

Table 19. Percent Distribution of Selected Characteristics for 754 Spouses and Children who participated in the Persian Gulf Spouses and Children Examination Program

Characteristic[a]	Spouses (N=285)	Children (N=469)
	%	%
Mean Age in Years	37.1[a]	7.0
Age Group		
Preschool	---	41.2
Elementary School	---	39.7
Middle School	---	8.1
High School	---	7.1
Unknown	---	0.0
Race		
White	65.3	51.0
Black/other	31.9	41.6
Unknown	2.9	7.5
Sex		
Male	3.5	48.8
Female	96.5	51.2
Contact with military equipment brought back from Gulf War by the veterans	80.7	55.9
Belief that health problems are related to the veteran's Gulf War service	79.3	65.5

[a]2 spouses' ages unknown

Table 20. Percent Distribution of Self-Reported Health Status for Index Veterans, Spouses, and Children in the VA Persian Gulf Spouses and Children Examination Program

Self-reported Health Status	Index Veterans (N=424)	Spouses (N=285)	Children (N=469)
	%	%	%
Very Good	4.7	8.4	12.2
Good	16.3	25.3	43.7
Fair	37.7	38.3	29.9
Poor	28.8	21.8	10.5
Very Poor	12.0	6.3	3.8
Unspecified	0.5	---	---

Table 21. Percent Distribution of Symptoms among Index Veterans, Spouses and Children

Symptoms Category	Index Veterans Initial (N=307)	Index Veterans Revised (N=117)	Spouses (N=285)	Children (N=469)
	%	%	%	%
Abdominal Pain	2.3	6.8	4.6	1.5
Diarrhea	6.2	18.8	2.5	2.8
Fatigue	27.7	30.8	16.8	4.9
Headache	19.22	31.6	24.2	6.0
Joint/Muscle Pain	20.9	41.0	9.1	3.6
Memory problem	20.9	37.6	3.9	2.3
Rash	20.9	29.1	7.0	12.8
Shortness of Breath	8.8	11.1	6.0	5.1
Sleep Disturbance	6.5	17.1	3.5	1.3

Table 22. Percent Distribution of Diagnoses Recorded for Index Gulf Veterans, Spouses and Children

Diagnostic Category	Index Veterans Initial (N=307)	Index Veterans Revised (N=117)	Spouses (N=285)	Children (N=469)
	%	%	%	%
Infectious and Parasitic Disease	6.2	7.7	6.0	3.2
Malignant Neoplasms	0.0	1.7	1.1	0.2
Endocrine Nutritional Metabolic Immunity	5.2	10.3	15.8	5.3
Blood and Blood-Forming Organs	1.3	4.3	1.1	0.2
Mental Disorders	17.3	25.6	24.9	9.4
Nervous System and Sense Organs	7.8	18.0	16.8	12.8
Circulatory System	4.9	7.7	9.5	2.6
Respiratory System	15.3	13.7	21.4	17.7
Digestive System	9.5	15.4	10.5	6.2
Genitourinary System	4.2	6.0	22.5	3.0
Skin and Subcutaneous Tissue	13.0	16.2	15.8	14.5
Musculoskeletal System and Connective Tissue	24.4	28.2	26.7	6.0
Symptoms, Signs, and Ill-Defined Conditions	3.6	10.3	16.5	12.4
Injury and Poisoning	5.2	1.7	5.3	2.1

Table 23. Agreement Between Diagnoses of Specific Veterans and the Diagnoses of the Corresponding Spouse and Children for Three Selected Health Categories

Health Category	Matching Ratio Among Family Members*	
	Spouses	Children
Infectious Diseases	0 / 28	0 / 28
Mental Disorders	1 / 83	0 / 83
Rash	12 / 98	31 / 98

*Specific family units were examined to find health conditions among the spouses and children that matched the condition in the index veteran. The Matching Ratio is expressed as the number of matches among spouses or children over the total number of index veterans with that condition.

(Appendix)

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